VHF Digital Link (VDL)/Time Division Multiple Access (TDMA) Radio Prototype Overview

VDLT Team

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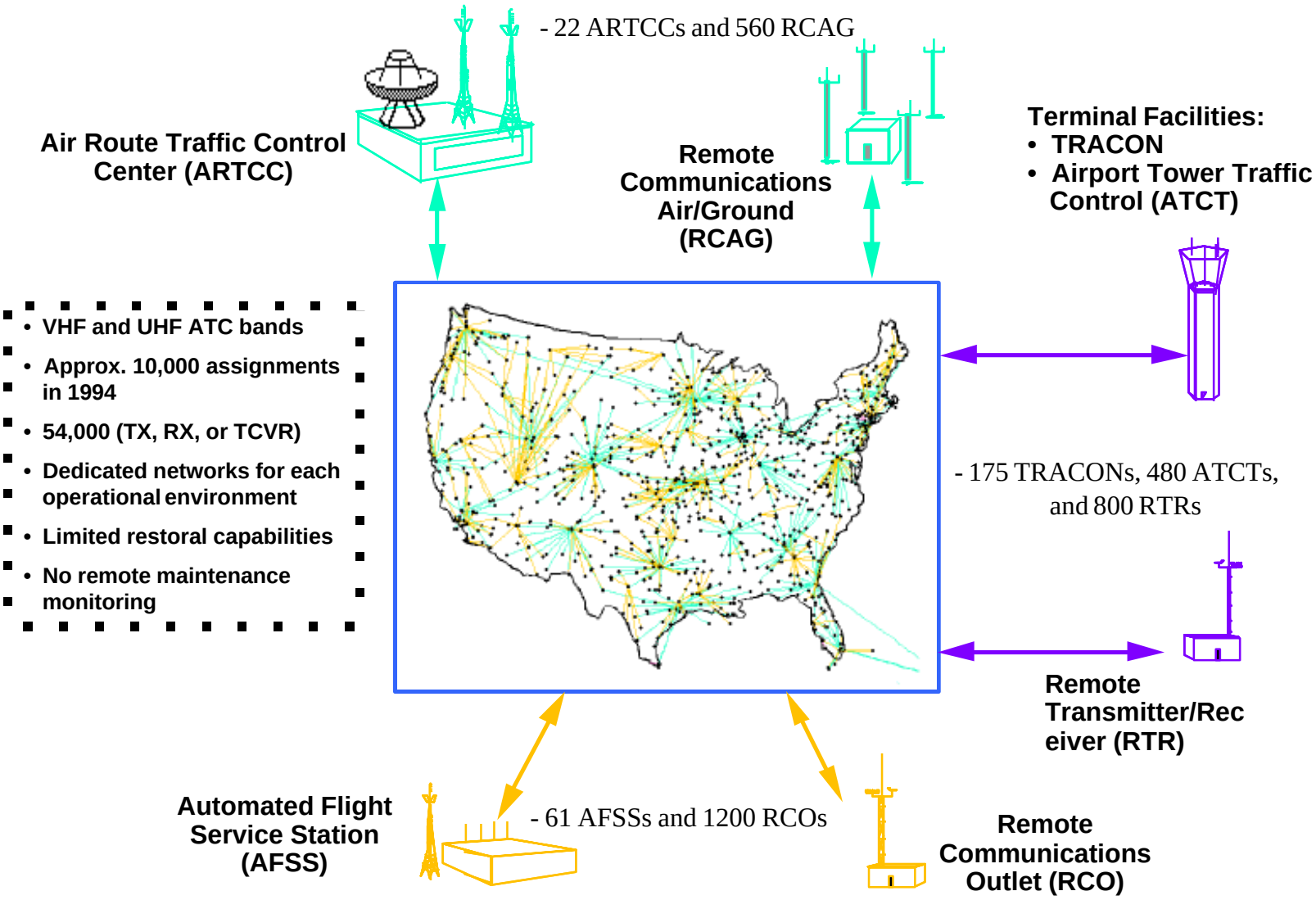
MITRE

Air/Ground Communications



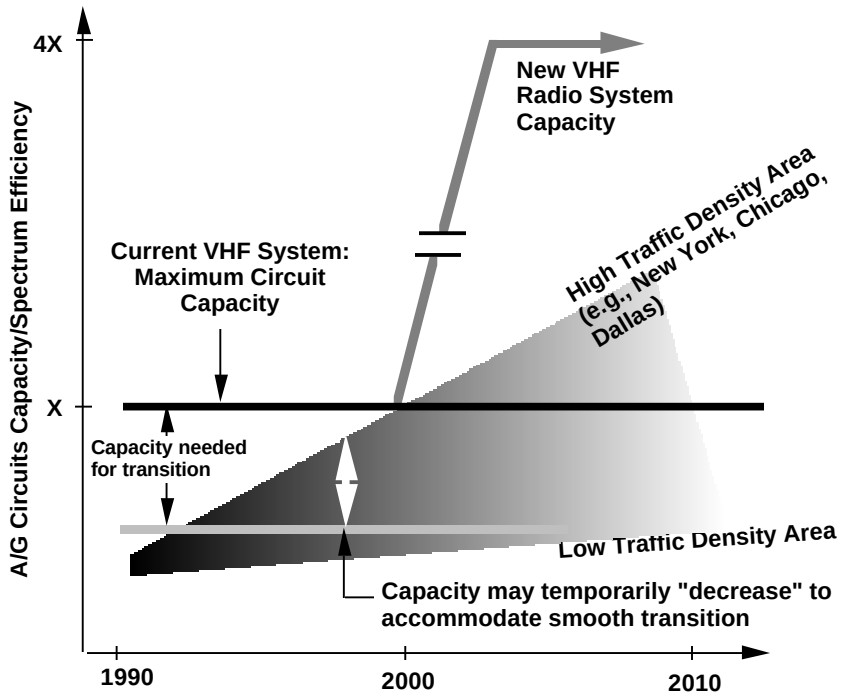
Basic Problems and Solution

Problem:

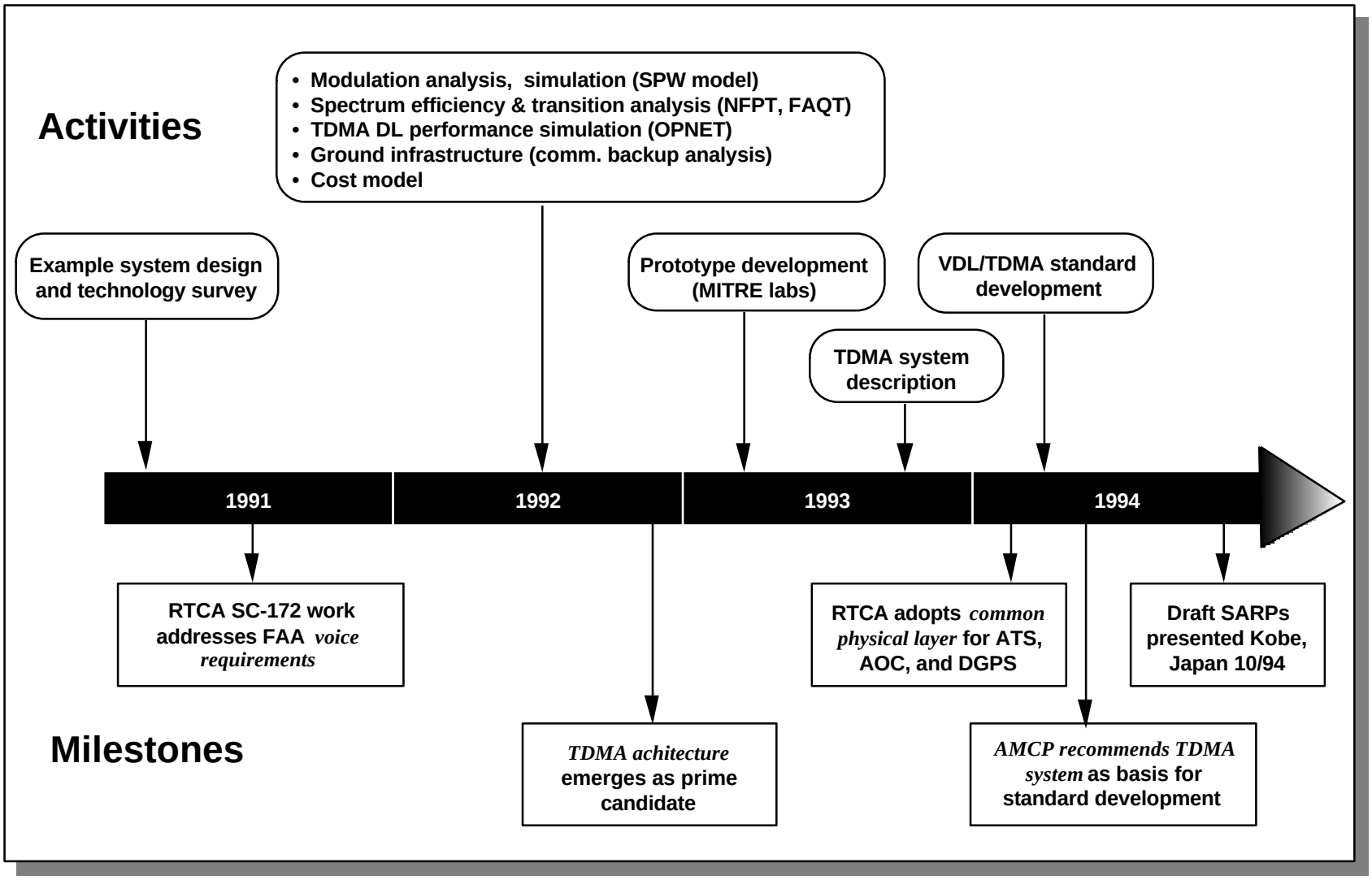
- **VHF spectrum in the US (and Europe) is near saturation to support new assignments for Air Traffic Services**
- **Radios nearing end of useful life**
- **Operational shortcomings of existing system**
- **AOC data needs expressed by industry**

Solution:

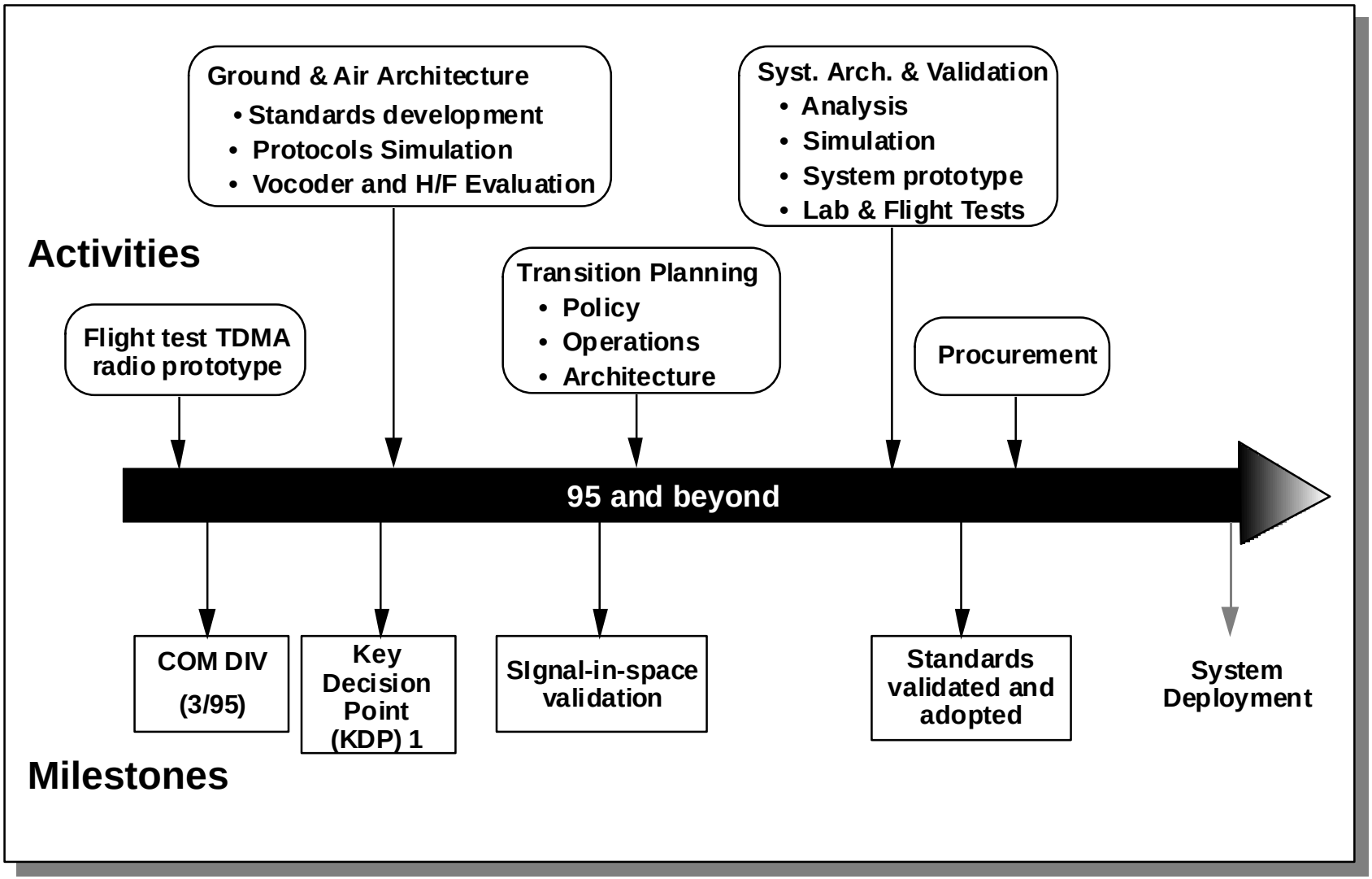
- **Adopt a new signal-in-space and multiplexing standards to increase spectrum efficiency**
- **Implement system with user benefits to encourage timely equipage**



Converging on the VHF Solution



Refining and Implementing the VHF Solution



New Requirements and Desirable Features

Requirements

System

- Capability to provide functionally simultaneous voice and data
- Minimize circuit blockage
- Increase security
- Increase RFI protection
- Reduce workload
- Facilitate transition
- Reduce circuit contention
- Provide automatic circuit management
- Support selective addressing
- Support failure detection and recovery

Voice

- Increase circuit capacity
- Reduce voice clipping
- Support prioritization of voice messages

Data Link (DL)

- Provide DL for all users
- Support msg lengths and capacity requirements
- Support prioritization of DL messages
- Undetected error rate/msg integrity
- Support msg delivery time
- ATN compatibility

Desirable Features

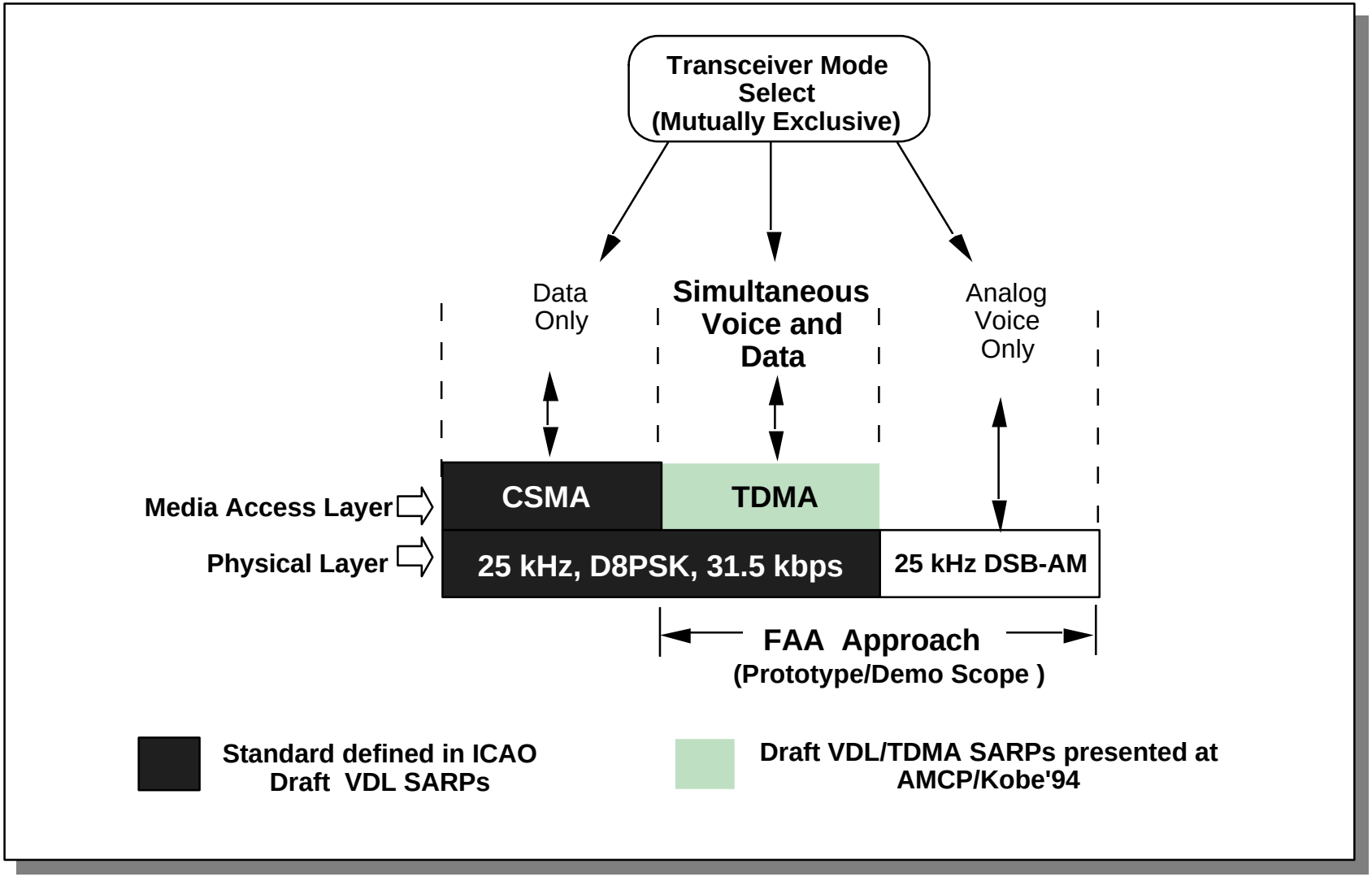
- All-digital VHF A/G comm system
- V & D comm functionally simultaneous from same avionics unit
- All-digital system w/ V&D on the same RF channel
- Call queuing capability
- Support preemption by controllers and specialists

Basic Digital VHF Radio Characteristics

TDMA mode based on VHF Digital Link (VDL) physical layer

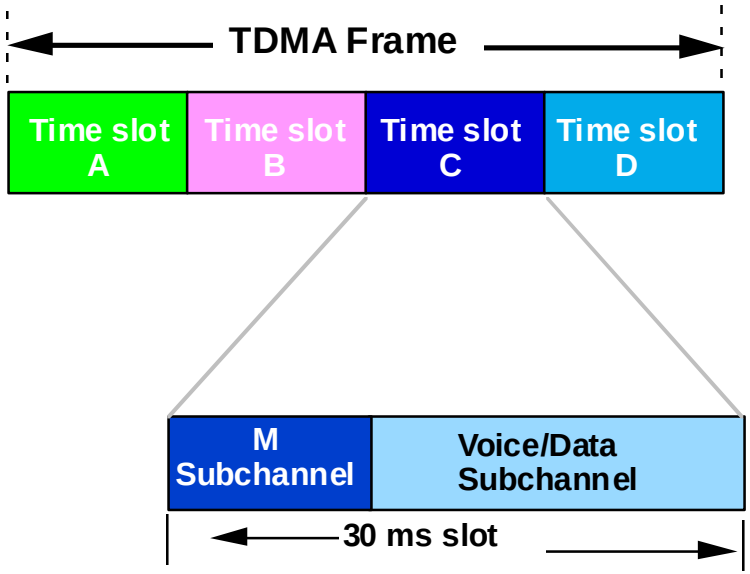
Frequency Range	**118–137 MHz**
Channelization	**25 kHz centers**
Channel Structure	**Same frequency for uplink and downlink**
Radio Range	**200 nmi for 4 channel capability** **(fewer channels for greater ranges)**
Symbol Rate	**10.5 kbaud (31.5 kbps ch data rate)**
Modulation	**D8PSK, non-coherent detection (3 bits/symbol)**
Operating Modes	**Dual mode (analog and digital)**
Voice	**4.8 kbps encoding, 250 ms end-to end latency**
Data	**Functionally simultaneous with voice**

Multimode Avionics Approach

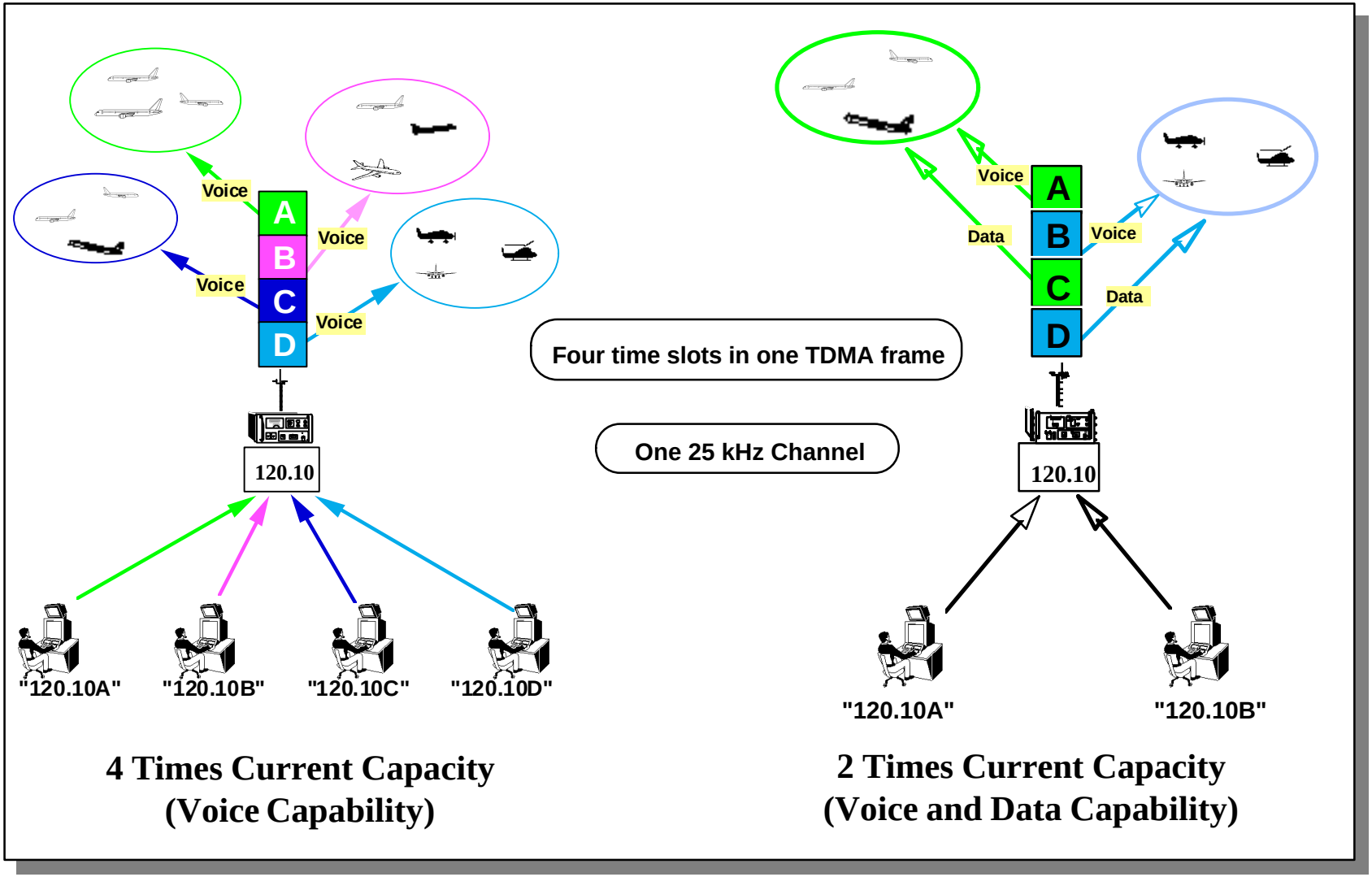


What is VHF Digital Link (VDL)/Time Division Multiple Access (TDMA) Mode

- Recommended by ICAO/ AMCP and RTCA SC-172
- TDMA timing hierarchy
  - 120 ms “TDMA frame” is the fundamental timing framework
  - Up to 4 “slots” are supported within the TDMA frame
  - Each slot supports separate voice or data circuit
  - Each slot contains two independent “subchannel bursts”



VDLT Radio Configuration Flexibility



4 Times Current Capacity
(Voice Capability)

2 Times Current Capacity
(Voice and Data Capability)

VDLT Radio System Architecture